



Making Optical Network OA&M Easy

The performance parameters that characterize modern optical networks are constantly changing. This is due to demand changes, environmental changes, maintenance, advanced electronics, complex new modulation formats, and more. They make monitoring your network a complex real-time challenge. You need to discover pressure points within the network before they become failures. It is essential to support a proactive operations, administration, and operations (OA&M) lifecycle for your optical network, while addressing greater demand for high bandwidth services, longer transmission distances, support of multiple data formats and higher bit rates, installation and verification tests, in-service performance verification to assure SLAs, channel troubleshooting and fault sectionalization, preventative maintenance, and dynamic service restoration.

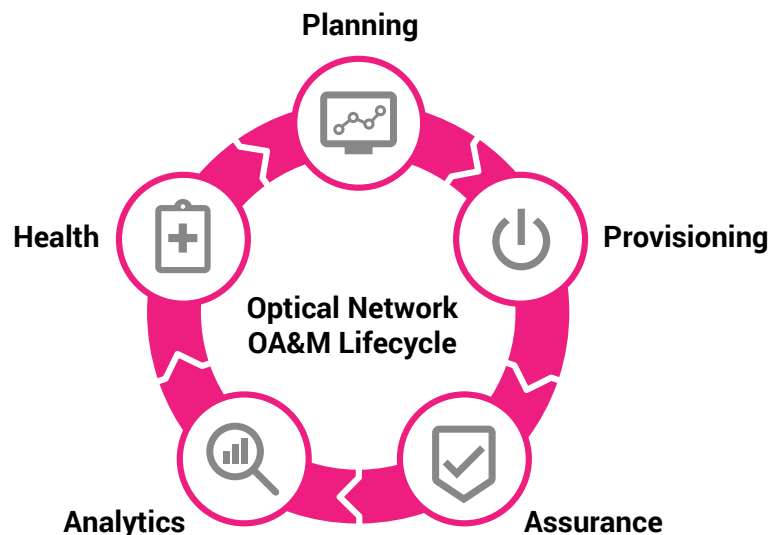
Intelligent Wave-length Management

fully embedded and automated, hands-free

Real-Time Measurement and history analysis

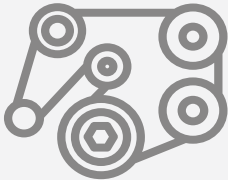


End-to-End Coverage

any Apollo or third-party wavelength



LightPULSE – Get Vital Info Instantly

Ribbon's LightPULSE accurately measures the performance of your Apollo optical network in real-time. It allows any Apollo or third-party wavelength to be accurately monitored across its entire optical span, in-service, and without the need for additional equipment. All reporting and controls are centralized, totally eliminating the need for truck rolls to dispatch technicians for manual measurements. LightPULSE is divided into three sets of capabilities:

Engine	GUI	OTDR
 <p>Complete suite of optical performance measurements delivered via a command line interface (CLI)</p>	 <p>Rich and intuitive interfaces to easily visualize and analyze performance data</p>	 <p>A powerful tool to quickly determine the location of problems along a fiber</p>

LightPULSE Engine



Real-Time End-to-End Optical Performance

LightPULSE uses integrated measurement capabilities and software algorithms that run in each Apollo network element. These cover all next-generation photonic features, including coherent transmission, 400GHz super-channels, and CDC-F ROADMs. Apollo accomplishes this without the need for any dedicated or additional cards. The LightPULSE engine gathers and communicates optical values for all active optical components, such as transceivers, ROADMs, and amplifiers, including:

- Fiber characteristic
- OSNR for each channel
- Channel input and output power
- Wavelength
- Chromatic Dispersion (CD)
- Polarization Mode Dispersion (PMD)
- Non-linearities
- Fault location

LightPULSE provides full end-to-end information on the optical trails in real-time. It gives you the information you need to maintain your network, and to set gain and equalization levels to ensure that the network is balanced and healthy.

Eliminate Truck Rolls

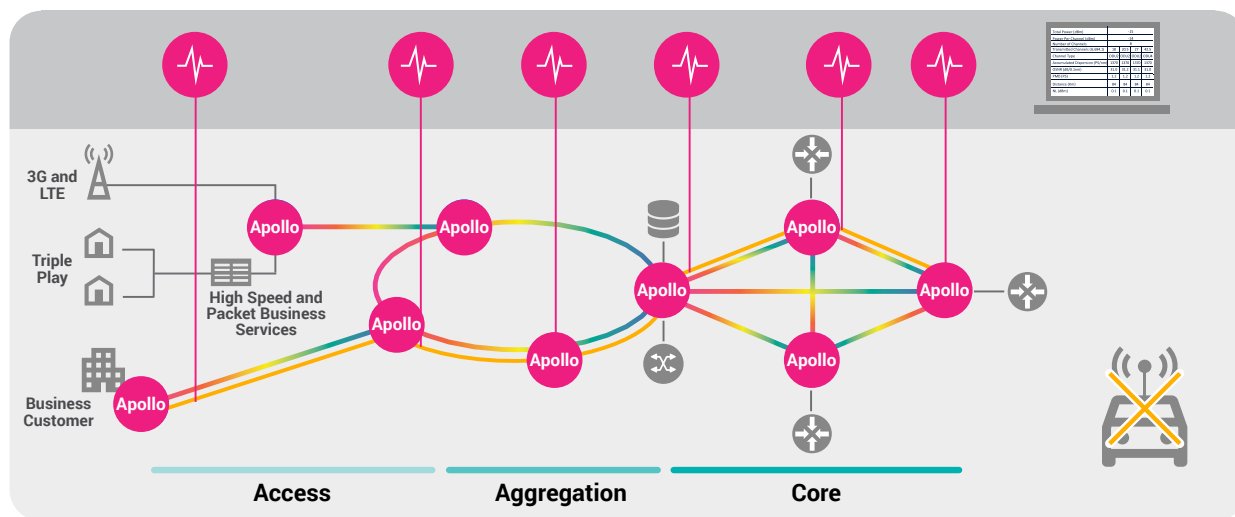
Fully embedded and automated, no hands-on

End-to-End Coverage

And Apollo or alien wavelength

Optimal Light Path Selection

For provisioning and restoration



Extends to Alien Wavelengths

Optical networks are rarely homogeneous. This is why LightPULSE was designed to integrate third-party alien wavelengths too, processing them just like any Apollo wavelength.

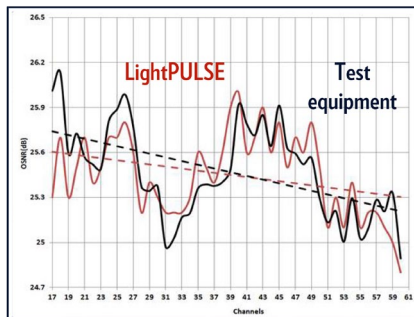
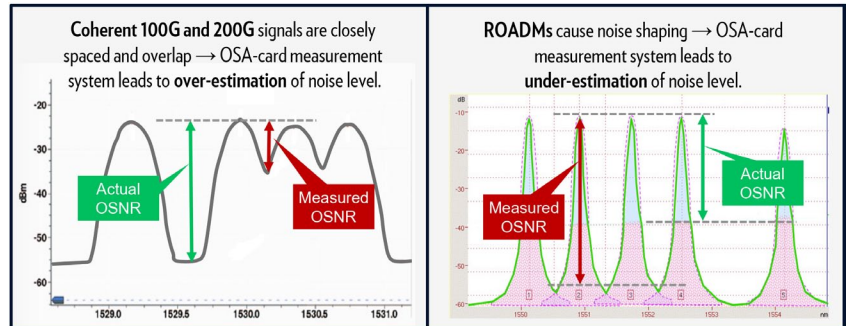
For each alien wavelength, network operators can configure a “virtual transceiver” with signal attributes and tolerance values aligned to the specific wavelength’s transceiver performance. This is capable of supporting multiple parameters like Tx power, Rx power, chromatic dispersion, and PMD.





Overcomes Measurement Challenges

Common wisdom claimed that making accurate measurements required truck rolls to equipment sites and manually applying optical spectrum analyzers (OSAs). Aside from the time and expense, such measurements also had technical challenges. For instance, OSNR (optical signal-to-noise ratio) is one of the most important parameters for analyzing a Digital Line Section (DLS) – an end-to-end wavelength route. But measuring OSNR for coherent channels and ROADM networks using OSAs is often difficult, leading to both under- and over-estimation of noise levels.

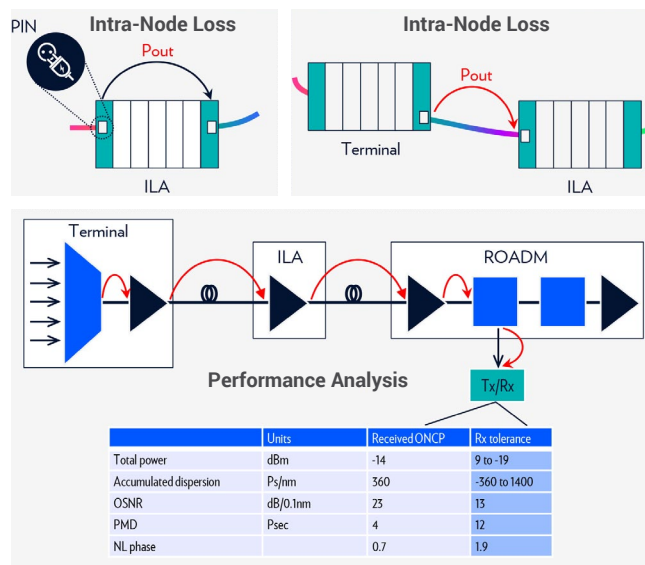


LightPULSE meets these challenges head on, based on the measurement capabilities integrated within the Apollo optical nodes. Moreover, LightPULSE is proven to provide accurate OSNR measurements that are not influenced by 100G/200G signal shapes or ROADM noise shaping. LightPULSE accuracy compares excellently with manual OSNR measurements, with less than 1dB deviation, across the entire spectrum.

Basis for Auto-Diagnostics and Warnings

LightPULSE can be set up to make measurements automatically and compare them against preset thresholds, as a basis for warnings and alarms. For example:

- Intra-node loss when an internal patch cord bend or failure occurs
- Inter-node loss when a fiber pair between two sites experiences a degradation or failure
- Performance analysis when an optical receiver threshold tolerance is crossed.



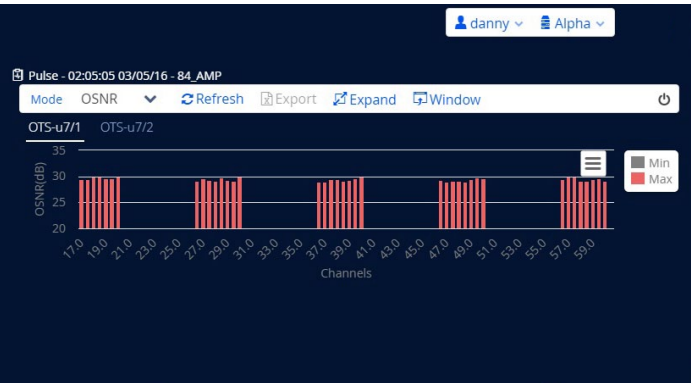
LightPULSE GUI

Raw measurement information can often be overwhelming. This is where LightPULSE's GUI capabilities provide tremendous added value. They allow visualizing and analyzing measurement information to facilitate fast and accurate decisions. Some of these capabilities are demonstrated here:

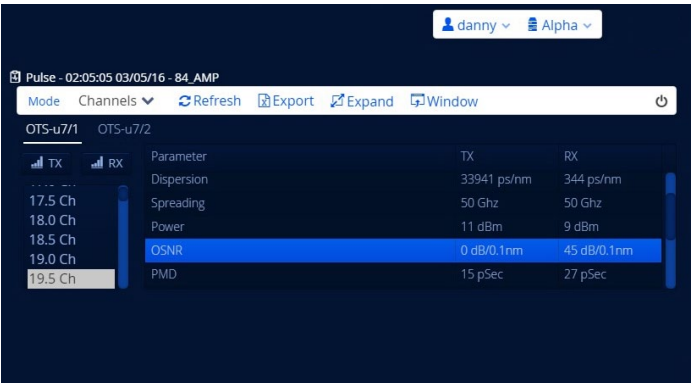
Real-Time Port or Channel Status



To assist in troubleshooting, LightPULSE GUI can drill down into the health of each optical port or channel, including: total power, power-per-channel, channels-per-port (ITU-T grids), service/rate-type per ITU-T channel, accumulated dispersion, OSNR, Polarization Mode Dispersion (PMD), distance and Non-Linear (NL) indication (accumulated power).



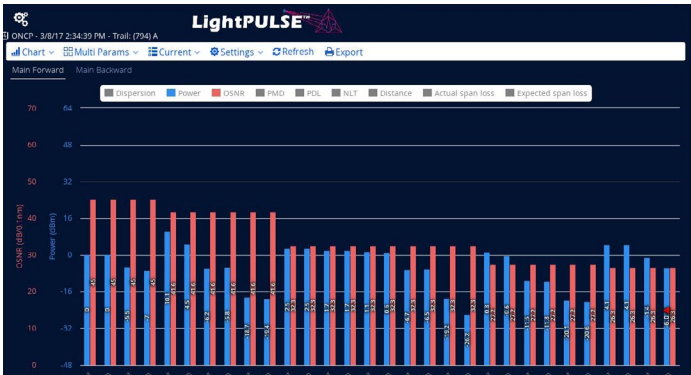
Real-time port status



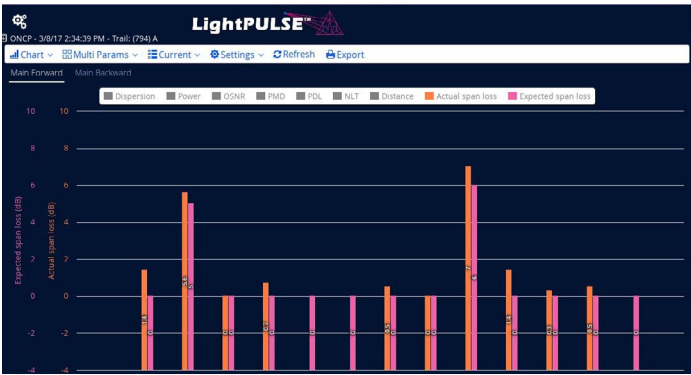
Real-time channel status

Real-Time Trail Status

Trail status can be retrieved in real time for each optical trail (OMS or OCH). Network operators can view each optical component (amplifiers, ROADMs, etc.) from the optical trail to obtain real-time optical impairment performance monitoring. Users can sort the information presented and create customized reports and graphs. Moreover, the user can select any other parameter and the graph will update accordingly.



OSNR, power, and CD, displayed simultaneously along the optical trail



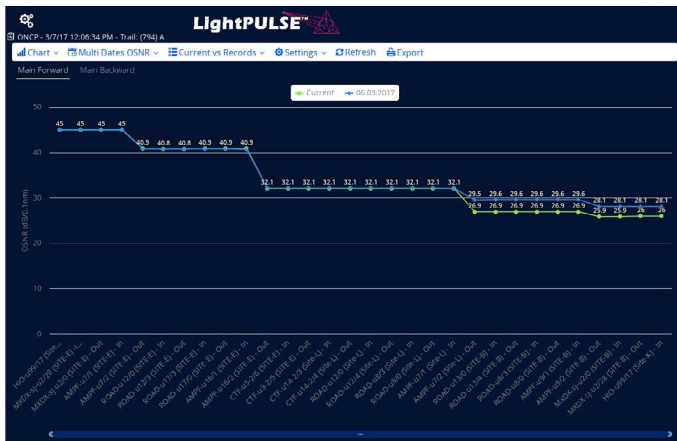
Actual vs. expected span loss



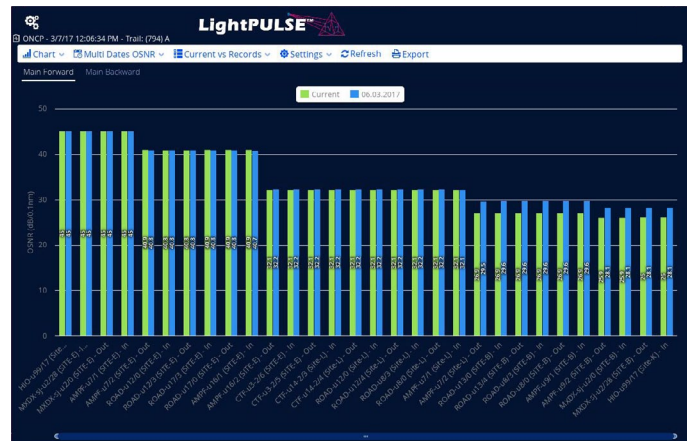
Current Versus Historical Data

LightPULSE GUI capabilities include automatically saving a snapshot of the network (per component) every day (last 7 days), every week (last 4 weeks), and every month (last 24 months), and giving an option to compare the records. This points out trends in the network, revealing problems before they become severe.

LightPULSE GUI also provides an analytic tool that calculates and shows Noise Figure degradation along the optical trail.



Current vs. historical OSNR



Current vs. historical power

LightPULSE OSNR Degradation Analysis

The LightPULSE OSNR degradation analysis feature is designed to provide warning of fiber degradation, based on a comparison between two measurements of optical channels at different dates/times.

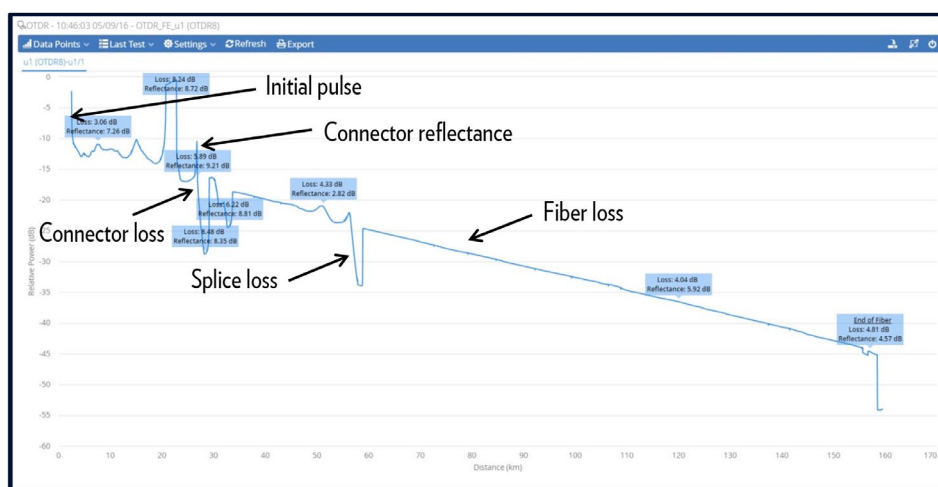
The feature shows the contribution of each event to the overall degradation, which impacts channel performance. This information enables the technician to pinpoint the location of the relatively more significant degradation for immediate reparation activity.



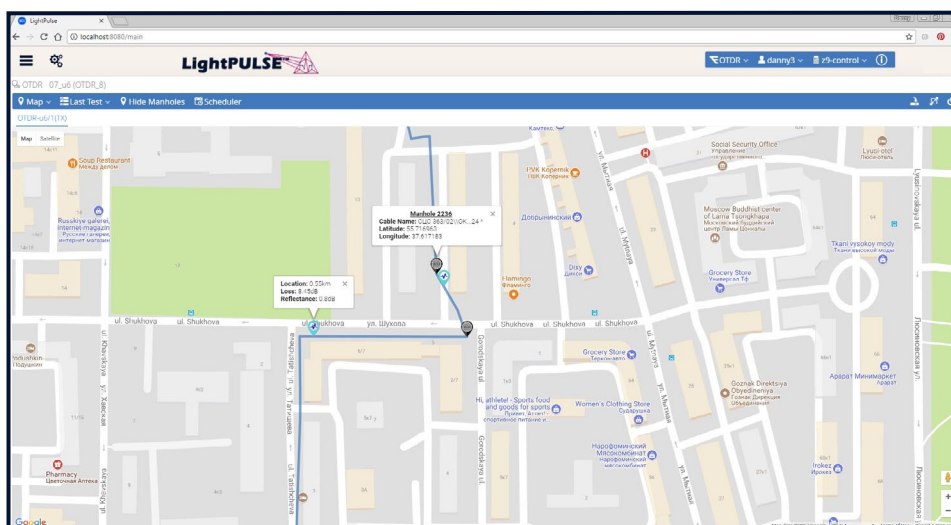
LightPULSE OTDR

Measuring optical performance conveys what is happening along an optical trail and can identify the location of problems within equipment. But if the problem is with the fiber itself, like bad splices or fiber breaks, you need additional tools to find out where these complications are - quickly and accurately. LightPULSE integrates Optical Time Domain Reflectometry (OTDR) to address this need. A pulse of light is sent down the fiber, and based on the reflected return patterns from the passive optical components, LightPULSE determines the location of the problem to within several meters.

To facilitate dispatch, LightPULSE then connects with a Geographical Information System and presents the latitude/longitude coordinates. This greatly reduces troubleshooting time and is an essential part of maintaining optical network health. With quick identification of optical fiber faults, service providers can improve their network resiliency and offer a better experience for customers.



An OTDR measurement provides a map of fiber characteristics



Geographical mapping enables accurate dispatch of maintenance personnel

Summary

LightPULSE dramatically reduces the cost and complexity of measuring performance and locating problems in your optical network. In short, it makes optical OA&M easy. Network operators do not have to invest in dedicated and expensive test equipment, or have a set of technicians available 24/7. It anticipates problems to avoid costly downtime, and minimizes downtime to a bare minimum if tough problems arise.

LightPULSE accomplishes this through a comprehensive set of measurement, visualization, and analytic capabilities. These range from getting a broad overview over what is occurring along an optical path to drilling down to the level of individual ports or channels, or even what is occurring along sections of fiber. Best of all, LightPULSE can work with alien wavelengths that run on top of your Apollo network.

LightPULSE offers operators a comprehensive view of their network health, with an extraordinary set of innovative real-time network monitoring capabilities for their Apollo and connected alien lambdas network, including:

- Elimination of CAPEX for OSAs, and reduced OPEX by avoiding truck rolls and field engineer on-site visits
- Solution to OSNR and non-linearity measurement challenges by providing prompt and accurate evaluations at each point and along each DLS/optical route
- Enhanced Automatic Power Control
- Detecting degradations over time before they become hard problems
- Fast sectionalization of hard problems if they do occur, to within specific equipment or locations along the fiber.

About Ribbon

Ribbon Communications (Nasdaq: RBBN) delivers communications software, IP and optical networking solutions to service providers, enterprises and critical infrastructure sectors globally. We engage deeply with our customers, helping them modernize their networks for improved competitive positioning and business outcomes in today's smart, always-on and data-hungry world. Our innovative, end-to-end solutions portfolio delivers unparalleled scale, performance, and agility, including core to edge software-centric solutions, cloud-native offers, leading-edge security and analytics tools, along with IP and optical networking solutions for 5G. We maintain a keen focus on our commitments to Environmental, Social and Governance (ESG) matters, offering an annual Sustainability Report to our stakeholders. To learn more about Ribbon visit rbbn.com.

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Contact us to learn more about Ribbon solutions.